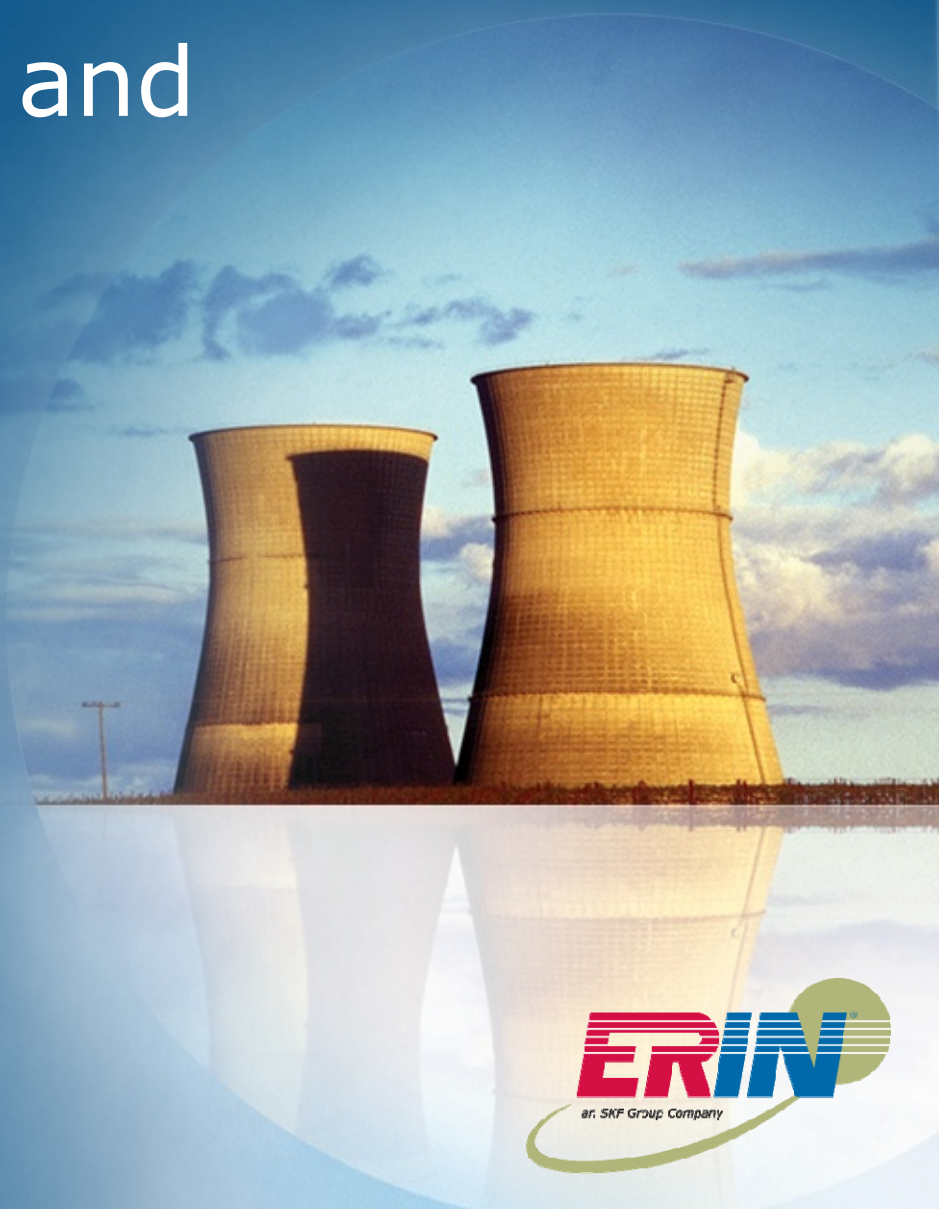


Defense in Depth and RG 1.174

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Overview

- What is the Defense-in-Depth (DID) philosophy?
- How is an adequate level of DID achieved?
- Issues with current guidance in RG 1.174 and SRP 19.2
- Suggestions for restructuring the guidance

Defense-in-Depth and RG 1.174

- Principle 2 of RG 1.174 “The proposed change is consistent with defense-in-depth philosophy”
- One of five principles that are to be dealt with in an integrated manner
- Experience has shown that the guidance for addressing DID in risk-informed decision-making is unclear

Regulatory Guidance

- RG 1.174
 - Provides seven guidelines for an applicant to use
- SRP 19.2
 - Focuses on the preservation of the effectiveness of barriers* and provides four objectives related to the effect of the change on the barriers
 - Provides the same seven guidelines for the reviewer to use in assessing whether the objectives are met
 - Discusses the role of PRA in addressing DID

*The SRP uses the term barriers, which include fuel cladding, RCS boundary, containment, and the EP actions

Defense-in-Depth Philosophy

- Several documents discuss DID, e.g., INSAG 10, SRM 98-114, NUREG-1860, but there is no single clear definition
- However, at a high level there is general agreement that DID involves:
 - Adopting a strategy of successive levels of protection, e.g.,
 - Prevention of core damage
 - Mitigation of release
 - Protection from effects of radiation
 - Implementation using methods that include:
 - Design using redundancy, diversity and independence
 - Procedures and training
 - Maintenance and surveillance practices
 - Defenses against common cause failures, etc.

Industry Concerns with Treatment of DID in RG 1.174

- Guidelines not structured hierarchically - address different aspects:
 - High level strategy (philosophy)
 - “reasonable balance,” “independence of barriers”
 - Implementation
 - Design issues - “fulfilling the intent of the GDC,” “avoid over-reliance on programmatic issues,” “redundancy, independence and diversity”
 - Programmatic activities - e.g., “defenses against CCF,” “defenses against human error”
- Intent of the guidelines is open to interpretation

Industry Concerns with Treatment of DID in RG 1.174 (Cont'd)

- Tendency to regard DID as a separate consideration rather than as an integral part of the decision-making
 - Principles 2, 4, and 5 in particular are highly interconnected
- Staff's current proposal of providing examples is not sufficient to clarify the guidance
- Some of the Staff's proposed examples raise additional questions, e.g.,
 - Was the intent of the guideline "defense against human error is preserved" to preclude new operator actions, or was it to prevent changes to training or procedures that might increase the likelihood of errors, or prevent changes that changed PSFs, such as workload?
- Temporary conditions (e.g., Technical Specification AOT changes) and permanent changes (e.g., design changes) may require different guidelines

Starting Assumptions

- For an operating plant, adherence to the DID philosophy can be presumed to have been established:
 - A reasonable balance between the levels of protection has been established
 - Effectiveness ensured by conformance with design standards and regulations
 - Administrative procedures and controls are in place
 - Vulnerabilities have been identified and addressed (IPE and IPEEE)
- A License Amendment Request (LAR) will not remove one of the levels of protection

High Level Objectives - SRP

- The change does not result in a significant increase in the existing challenges to the integrity of the barriers
- The proposal does not significantly change the failure probability of any individual barrier
- The proposal does not introduce new or additional failure dependencies among barriers that significantly increase the likelihood of failure compared to the existing conditions
- The overall redundancy and diversity among the barriers is sufficient to ensure compatibility with the risk acceptance guidelines

Assessment of High Level Objectives

- For those aspects of the plant that are addressed in the PRA, at an integral level, these objectives are met if Principle 4 is met
- However, the relative contributions of individual contributors (e.g., cut sets, basic events) to the metrics may have changed
- The effects of the change may not be fully understood (new unknowns introduced)
- Not all aspects of plant design and operations are addressed in the PRA (e.g., emergency planning, late containment failure)

Proposed Approach

- Structure the guidance recognizing the hierarchical aspect of DID
- Focus on the way the LAR affects the presumed balance between the levels of protection:
 - Physical changes to the plant
 - Changes to operating practices
- Provide guidance on the integration of DID concerns with the other principles

What should the Role of DID be in an Integrated Decision?

- Identify and assess changes that may adversely affect achieving a required safety function when the level of redundancy or diversity is limited or where significant uncertainty exists
- Identify and assess the impact on DID of cross-cutting changes (e.g., administrative changes, maintenance practices) that affect multiple safety functions or cut across levels of protection
- Use for things that can not be addressed directly by the PRA, e.g., late containment failures

Interaction with other Principles – Principle 4

- Meeting the acceptance guidelines of Principle 4 demonstrates that, at an integral level, DID is maintained for issues related to CDF and LERF
- However, if the change affects only low frequency and low order cut sets, DID is a relevant consideration
 - Contrast proposals for a change to surveillance frequency on RPV with change to surveillance frequency on LPCS system (BWR)
 - Former appears in single element cut sets, the latter in cut sets of high order, i.e., other systems perform the same function
 - Furthermore, there is much more uncertainty about the RPV failure probability than that of the LPCI system
 - Therefore, while the change for the RPV might be allowed, the case would need to be much stronger

Interaction with other Principles – Principle 5

- One of the reasons for preserving defense-in depth is to deal with unknown effects, in the case of a license amendment, unanticipated impacts of the change
- Since the area of uncertainty is known, the establishment of an effective performance monitoring program is an approach to addressing this new source of uncertainty

Summary

- Restructure the guidance in a hierarchical way that recognizes the philosophy as being the preservation of the effectiveness of approaches used to establish the existing levels of protection
- Provide a clarification of the intent of the existing guidelines that relate to the methods used to ensure the balance is maintained
- Emphasize the interrelated nature of the five principles to ensure that DID is considered appropriately as an integral part of the decision
 - Provide guidance on using the qualitative insights of the PRA to provide appropriate focus